REMARKS/ARGUMENTS

Reconsideration is respectfully requested of the Final Office Action of April 11, 2008.

Entry of the foregoing amendment is respectfully requested for the purpose of placing the application in condition for allowance, or alternatively, in better condition for appeal.

By the foregoing amendment, the features of Claims 7 and 11 have been introduced into Claims 1 and 25 in order to expedite favorable action. The claims in the case are 1 to 6, 8 to 10 and 12 to 25. Claims 14 to 24 stand withdrawn.

The rejection of Claims 1-6 under 35 U.S.C. § 103(a) as unpatentable over the 1995 *Nunan* SAE paper is traversed and reconsideration is respectfully requested.

The Final Action of April 11, 2008 points to page 3 of the SAE *Nunan* paper and alleges that the SAE paper renders the presently claimed subject matter obvious to one of ordinary skill in the art. Applicant disagrees and contends that this paper in fact supports the claims in the current application.

The SAE paper shows that under the conventional preparation conditions described for a TWC (three-way catalyst) washcoat , alloying between Pd and Rh or Pt and Rh is expected and observed. See Introduction on page 1 of the paper.

Extensive performance data in support of alloy formation is presented in the SAE paper. In particular, data shows that when alloying occurs between Pt-Rh there is little negative impact on the performance of the catalyst. This is well known in the scientific literature as the surface of Pt-Rh alloy crystallites are enriched in Rh. The performance of aged Pt-Rh catalysts is dominated by the Rh function. As a result alloying for Pt and Rh has little or no impact on

performance with the exception of a small impact on hard HC oxidation, see Figures 1, 2 and 3 of the paper.

Although alloying of the platinum and rhodium has little or no impact on performance as noted, the same is not true for palladium-rhodium alloy formation.

When Pd and Rh are added to the wash coat (WC) together and exposed to normal TWC aging conditions extensive alloy formation occurs. Pd-Rh alloy crystallite surfaces **are enriched in Pd**, thus hiding the Rh and suppressing performance functions associated with Rh. The dominant performance function associated with Pd is hydrocarbon oxidation while **Rh is critical for NOx conversion.** Thus, alloying of Pd and Rh is characterized by a dramatic loss of the Rh function (loss of NOx conversion activity and also CO performance) when both metals are present together in the support. As a result, in conventional TWC catalysts special measures are taken to separate Pd and Rh physically. Evidence for alloy formation between Pd and Rh is clearly shown in Figures 4 (CO) and 5 (NOx) of the 1995 SAE Nunan paper. This evidence is easily derived from the performance features of the Pd-Rh catalysts when both metals are in the WC (wash coat) together. Figures 4 and 5 (see page 4) show that when Pd and Rh are in the WC together a dramatic decrease is obtained in CO and NOx conversion, respectively. Further, if some pretreatments of the catalyst are carried out to de-alloy the Pd-Rh (separation of the metals) some recovery of the NOx performance is clearly seen. This can be achieved by high temperature treatment under oxidizing (lean) conditions. The recovery of NOx performance is shown in Figure 7 of the paper after lean pretreatment at an A/F = 14.9 at 900°C for 1 hour.

In conventional TWC catalyst designs the Pd and Rh are invariably kept apart either by layering (Pd located in one layer and Rh in the other layer) or by separation within the same WC or layer through pre-impregnation or selective platinum group metal (PGM) placement. In fact this is described in the US 6,335,305 patent by *Suzuki et al.* (of record). Separation of the metals is implied by *Suzuki et al.* in his Claim 12 where Suzuki states "The Catalysts of Claim 1, wherein Pd is loaded on the composite oxide; and at least one of Pt and Rh is loaded on the support". Thus, Suzuki recognizes that Pd and Rh need to be kept physically separate as is the conventional design strategy for Pd-Rh TWC catalysts.

In contrast to what is shown in the *Nunan* SAE paper, attention is invited to the Figures 7 and 8 which accompany this application which show different peaks for the presence of palladium and rhodium to form a non-alloyed, one-layer catalyst. If an alloy were to be formed, there would not be two different peaks. Different peaks shown in the x-ray defraction patterns represented by Figures 7 and 8 demonstrate that the one-layer catalyst of this invention is essentially non-alloyed.

Contrary to the Examiner's comments, this paper clearly states that inclusion of Pd and Rh in a single WC layer is not desirable. The SAE paper teaches against such a design strategy.

The SAE paper describes the impact of Pd/Rh and Pt/Rh interactions on the performance of TWC catalysts. Catalysts are prepared and compared where both Pd and Rh or Pt and Rh are included in the same WC (allowed to interact and form alloys) or where they are specifically kept separate (physical mixtures of pre-formed impregnated powders). The resultant impact on overall catalyst performance is examined. The SAE paper concludes that the optimum

configuration is separation of the precious metals (PMs), especially Pd and Rh. This arises as PMs in the same WC layer inevitably form alloys during aging and testing and the performance is dominated by the nature of the alloy. For aged Pt/Rh catalysts the performance is dominated by the Rh function. This arises for two reasons: 1) Rh on a per mass basis is more effective than Pt for CO/HC oxidation and especially NOx reduction and 2) the surface of the alloy in contact with the exhaust gas is enriched in Rh. For the Pd/Rh catalysts the opposite is true. The alloy surface is enriched in Pd so the Rh function is suppressed or hidden. This results in a loss of Rh function and suppressed activity for CO/HC oxidation and NOx reduction in comparison to a situation where both metals are intentionally kept separate and not allowed to interact. In the SAE paper these conclusions are clearly stated in the Abstract, the body of the text and the Summary.

In the Abstract, this conclusion is clearly stated in the following text:

> "Pt-Rh alloy formation was found to have a detrimental impact on high temperature HC performance. In contrast to the Pt-Rh system, alloying between Pd and Rh resulted in performance features more like Pd-only and alloying did not adversely impact high temperature HC performance but instead had a large negative impact on NOx performance. Overall no benefits to alloy formation were observed and optimum performance required separation of the metals in either case."

In the body of the text the data in Figures 5 and 7 emphasize the negative effects of having Pd and Rh in the same WC layer (i.e. in intimate contact such that alloy formation can occur). Thus, in Figure 5 it is seen that the high temperature performance for NOx is suppressed for the Pd-only and Pd/Rh catalysts where both PMs are co-impregnated – in intimate contact.

Best performance is observed for Rh-only or where both PMs are intentionally kept separate. The critical importance of separating the Pd and Rh is further shown in Figure 7 where it is shown that a high temperature lean/oxidizing pre-treatment improved the activity of the Pd/Rh catalyst where both PMs were co-impregnated. This is explained by de-alloying and separation of the PMs (c.f. Graham et al., reference 11) and exposure of the Rh to the exhaust gas.

Finally in the Summary part of the SAE paper, it is clearly stated that the optimum configuration for a Pd/Rh technology is separation of the Pd and Rh and not their inclusion in a single layer. For conventional TWC catalyst designs this is achieved by layering and adding the Pd in one WC pass or layer (typically Layer-1) and the Rh in a second WC pass or layer (Layer-2). Thus, the summary states:

> "In the case of Pd/Rh systems alloying had appreciably more negative effects on performance and suppressed the Rh function for CO and especially for NOx. The results indicate that catalyst preparation **strategies** should emphasize separation of the PMs. The dynamometer studies are in qualitative agreement with the laboratory studies. No clear benefits to co-impregnation with accompanying PM alloying were observed and the separated PM preparations showed benefits for NOx and HC performance as predicted from the laboratory studies."

In contrast to the results presented in the 1995 SAE paper, it is now found that with the use of the new WC materials described in US 2005/0129588 A1 and now recited in Claim 1, Pd and Rh can in fact be included in the same layer with no observable negative effect on performance. This is shown in Figures 2, 3 and 4. In this comparison the Pd and Rh are separated into two WC layers in 2-layer A catalyst in one case and are included together in 1-

layer A catalyst in a second case. The total WC load is identical as well as WC composition. The only difference is that the Pd is added separately as the 1st WC pass was 50% of the WC load and the Rh in a 2nd pass with the remaining 50% of the WC load. It is observed that after aging we see no difference in performance between the 2-layer A catalyst and 1-Layer A catalyst in performance. The explanation for this is that the materials of the new 1-layer formulation prevent alloy formation as shown in Figures 7 and 8. This is an unexpected result. However, the reason why these new meso-porous OSC and alumina supports prevent alloy formation between Pd and Rh is not clear.

The SAE *Nunan* paper does not disclose a one-layer formulation of catalyst wherein 70% or more of the first catalyst and the second catalyst are non-alloyed under alloying conditions. Consequently, the SAE *Nunan* paper fails to disclose an essential feature of the present invention.

Neither is there any suggestion or teaching in the SAE *Nunan* paper which would provide a reason for a person skilled in the art to arrive at applicant's invention of a one-layer catalyst where at least 70% or more of the first and second catalyst are non-alloyed. In fact, the SAE paper teaches away from the present invention and would lead one skilled in the art to separate the Pd and Rh components.

Accordingly, applicant respectfully submits that the SAE *Nunan* paper fails to create *prima facie* obviousness for the claimed invention and, therefore, the rejection should be withdrawn.

The rejection of Claims 7-10 under 35 U.S.C. § 103(a) as unpatentable over the SAE *Nunan* paper in view of *Fujitani, et al.*, US 4,239,656, (*Fujitani*), is traversed and reconsideration is respectfully requested. The subject matter of Claim 7 has been incorporated into Claim 1 and Claim 10 has been deleted. This leaves for consideration Claims 8 and 9 which have been made dependent on Claim 1.

The SAE *Nunan* paper has already been discussed above and, as noted, fails to show an important feature of the present invention; namely, that the one-layer catalyst has 70% or more of the first catalyst metal and the second catalyst metal present in a non-alloyed condition.

Fujitani shows a variety of catalysts and also discloses the gamma alumina catalyst support. However, even if the catalyst support of *Fujitani* were used in the *Nunan* formulation, the combination would still not arrive at the subject matter of Claims 7-10.

More particularly, *Fujitani* does not render the present invention obvious for the following reasons:

i) The particle size and pore size distribution (0.01–2 microns) described by *Fujitani* relates to the fact that he is preparing $MgAl_2O_4$ spinel materials by calcining a mixture of alumina and magnesia at up to 1350°C. Calcination at such high temperatures typically generates fully dense, low surface area materials as seen in Tables 4 and 6 of *Fujitani*.

ii) The Official Action of April 11, 2008, makes reference to *Fujitani,* at col. 10, lines 65–68, where there is a disclosure of an alumina-magnesia support (shown in Table 5, in col. 9) which *Fujitani* identifies as the C2 support material having a pore volume of 0.5 cm^3/g, a pore diameter of 0.02 microns and a surface area of 98 m^2/g. However, carrier 2 is a

comparative carrier which is NOT in fact a part of the *Fujitani* invention. This is specifically stated later in col. 11, lines 21– 25, where it is stated that the C2 support material is in fact not of the invention being described by *Fujitani*. Thus, *Fujitani* states in col. 11, lines 21 - 25: "It is also evident that the catalysts (S3 and S4) having the carrier (No. C2) prepared by depositing ceria on the conventional carrier have much lower activities than the catalysts of the present invention." *Fujitani* clearly teaches away from using carriers of the type shown in his comparative carrier examples in Table 9.

iii) In conclusion, the basis of the *Fujitani* invention is that the support for the PGMs (Pt, Pd and Rh) consists of a low surface area composite material consisting of $MgAl_2O_4$ spinels, alumina and ceria and that the catalyst preparation involves the physical separation of Pd and Rh in the formation of the final catalyst. *Fujitani* does not suggest a 1-layer catalyst as defined herein and fails to contain any suggestion that the catalyst described in the SAE paper should be modified in any way, and certainly does not suggest taking steps that would be contrary to what is recommended in the SAE paper. And, if the porous support of *Fujitani* were to be used in the configuration shown in the SAE paper, the result would still not reach the claimed invention.

Accordingly, applicant respectfully submits that the combination of SAE *Nunan* paper with *Fujitani* fails to create *prima facie* obviousness for the presently claimed subject matter. Applicant therefore respectfully requests that the rejection be withdrawn.

The rejection of Claims 11 and 12 under 35 U.S.C. § 103(a) as unpatentable over the SAE *Nunan* paper when taken with the *Fujitani* patent '656 and further in view of *Anatoly, et al.*,

US 6,387,338, is traversed and reconsideration is respectfully requested. Claim 11 has been combined with Claim 1 and Claim 12 is now dependent on Claim 1.

The rejection of Claim 13 under 35 U.S.C. § 103(a) as unpatentable over the SAE *Nunan* paper taken with *Fujitani* '656, and further in view of *Suzuki, et al.*, US 6,335,305, is traversed and reconsideration is respectfully requested.

The combination of the SAE *Nunan* paper with the *Fujitani* '656 patent has already been discussed above, and the reasons apply here as well.

In the current invention the complete absence of alloy formation for the 1-layer Pd-Rh catalysts is shown from the X-ray diffraction patterns in Figures 7 and 8 and the absence of any performance penalties (especially for NOx conversion in Figures 2–6) when the 1-layer Pd-Rh technology is compared to 2-layer technologies where Pd and Rh are physically separated. Further, when RAT (Rapid Aging Test) agings are carried out that contain high temperature reducing/rich exhaust conditions that promote alloy formation between Pd and Rh, we further observe no performance penalties for the 1-layer Pd-Rh catalysts as shown in Figures 9 and 10. While the precise reason why alloy formation does not occur for the 1-layer Pd-Rh technology is not clear, applicant believes that it is related to the specific material types used in the wash coat composition. Thus, Claim 1 has now been amended to describe the characteristics of these wash coat materials in terms of their composition, morphological (porosity) and structural (cubic phase for the oxygen storage components) properties.

Anatoly '338 is acknowledged in the present application on page 12, para. [0046], and adds little if anything to the combination of prior art relied on in paragraph 6 on page 5 of the

Official Action. Since the SAE *Nunan* paper fails to teach the non-alloyed condition of the precious metals as required by the claims, it is respectfully submitted that the combination cannot render the subject matter of the present claims *prima facie* obvious.

The *Suzuki* patent is relied on to show a catalyst for purification of the exhaust gases wherein an oxygen storage component having a cubic structure is present.

Suzuki shows a conventional catalyst material and even if the cubic structure of *Suzuki* were somehow incorporated into the combination resulting from SAE *Nunan* paper taken with *Fujitani* '656, the final combination of teachings would still not arrive at applicant's invention as claimed in Claim 13.

Accordingly, applicant respectfully submits that the combination of SAE *Nunan* paper, *Fujitani* '656, *Anatoly* '338 and *Suzuki* '305 fails to arrive at the present invention and does not create *prima facie* obviousness for the presently claimed subject matter.

Therefore, applicant respectfully requests that the rejections be withdrawn.

The rejection of Claim 25 under 35 U.S.C. § 103(a) as unpatentable over the SAE *Nunan* paper taken with *Fujitani* '656 and further taken with *Foster*, US 5,857,140, is traversed and reconsideration is respectfully requested. Claim 25 has been amended to incorporate the subject matter of former Claims 7 and 11.

The combination of the SAE *Nunan* paper and *Fujitani* '656 has already been discussed above and the failings of that combination have been explained and the reasons set forth for traversing that rejection apply here as well.

Foster is relied on for the showing of a retention material in an exhaust gas treatment device.

Even if the retention material of *Foster* were added to the combination resulting from the teachings of the SAE *Nunan* paper and *Fujitani* '656, applicant respectfully submits that the combination of the three documents would not render the subject matter of Claim 25 *prima facie* obvious.

Accordingly, for reasons set forth above, applicant respectfully requests that the rejection be withdrawn.

Reference is made to the copies of the x-ray fracture patterns of a typical palladium-rhodium one-layer catalyst, prepared according to the invention where the palladium and rhodium are essentially non-alloyed, of record.

Once again, it is emphasized that in the conventional type of catalyst formulations such as disclosed in the SAE *Nunan* paper of 1995, there is no teaching or suggestion of the benefits to be arrived at by having a one layer catalyst where the first and second catalyst are non-alloyed as established by the x-ray fracture patterns shown in Figures 7 and 8 of this application.

In summary, it is respectfully submitted that none of the references teach the essential feature of the present invention; namely, that beneficial results can be obtained in a one layer catalyst by adding the first and second metal in a non-alloyed condition as defined in Claim 1.

For reasons set forth above, favorable action at the Examiner's earliest convenience is respectfully requested.

Respectfully submitted,

SMITH, GAMBRELL & RUSSELL, LLP

By: ______________________
Robert G. Weilacher, Reg. No. 20,531

Date: July 10, 2008
Suite 3100, Promenade II
1230 Peachtree Street, N.E.
Atlanta, Georgia 30309-3592
Telephone: (404): 815-3593
Facsimile: (404): 685-6893